LBPWG HACK DAYS REPORT

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LI Local Meeting

February 22, 2017

LBPWG Hack Days

- February 16-17 at Fermilab
- People: Matt Bass, Mayly Sanchez, Tingjun Yang, Elizabeth Worcester, Laura Fields, Chris Backhouse, Dan Cherdack, Chris Marshall, Cody Milne, James Norris
- Tasks
  - **Write code to extract GLoBES configurations from FDMC for simple sensitivity studies (Elizabeth, Matt)**
  - Train users in LOAF (Dan, Laura, Chris M.)
  - Port CAFAna (NoVA fitting software) to DUNE (Chris B.)
  - Help us understand MVA results (Tingjun)
  - Discuss/understand how to incorporate ND results into various fits (Dan, Chris M., all)
  - Learn GLoBES (James, Cody)
- Started using the new “dunescience” slack channel
- Very useful couple of days

Status of MVA-based Sensitivities

- First pass at MVA ν_e and ν_μ event selections have been presented/discussed at long-baseline PWG meetings for the past ~year
  - Still not terribly sophisticated – work needed to understand whether poor results are from the MVA itself or shortcomings in the reconstruction that feeds into it
- Output of MVA selection has been used as part of NDTF work to produce sensitivity results using LOAF/VALOR
- LBPWG has not had a simple way to perform sensitivity studies using these results without resorting to the full reweighting offered by LOAF and associated scripting framework
  - Format not standard GLoBES, so not useful to outside/phenomenology collaborators
  - Lots of files to deal with that are not needed for our purposes
  - We wanted something simple with the same format as our CDR GLoBES configurations

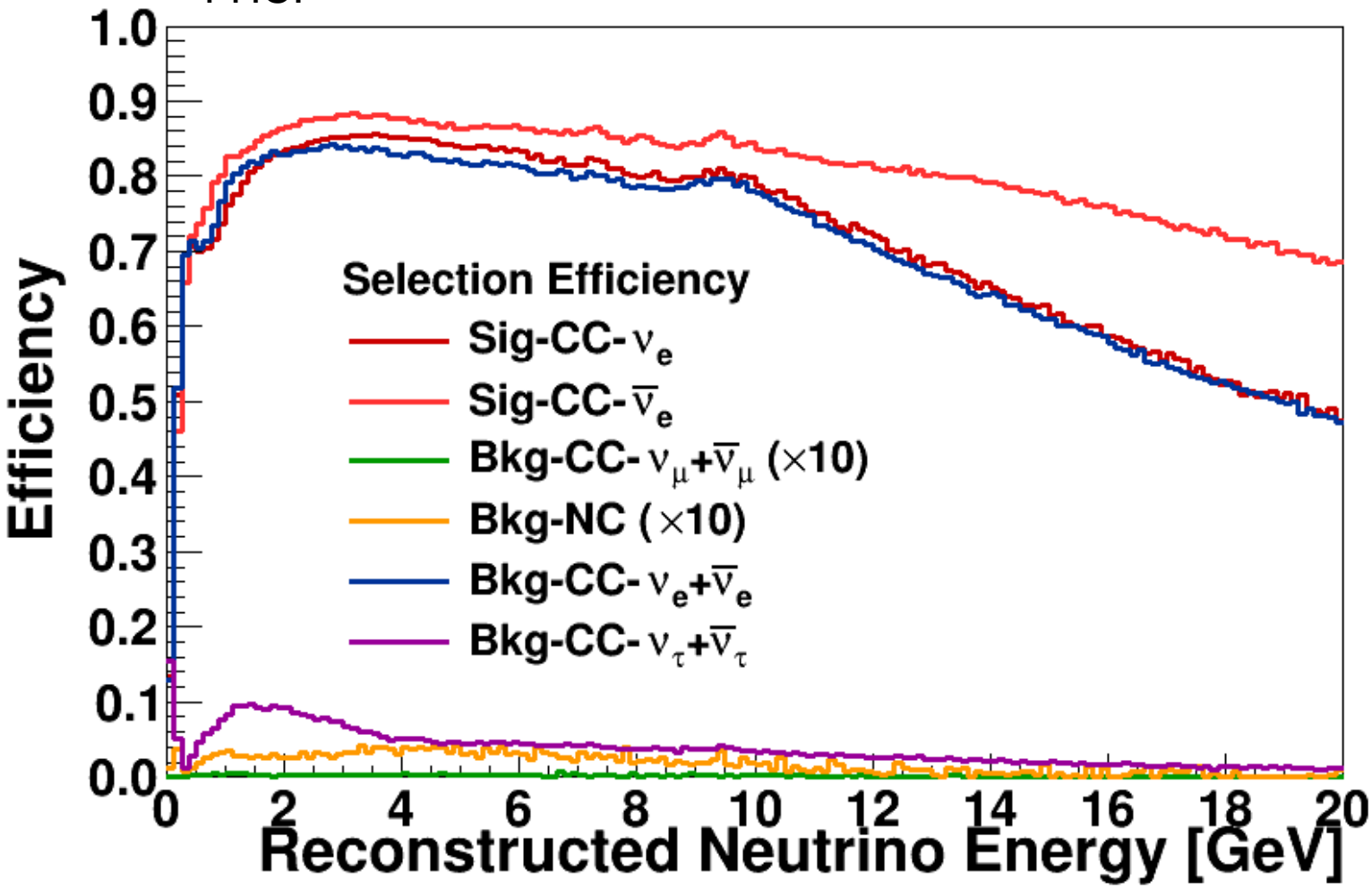
New Work at Hack Days

- Write python script to extract GLoBES configurations directly from the FDMC "MVASelection" tree
  - Simple "Draw" commands to create histograms of efficiency and purity for different samples
  - Text parsing to write out GLoBES files in required format
- Check resulting GLoBES configurations
- Produce event spectra and CPV/MH fits from resulting GLoBES configurations
- Commit code to DUNE github:
  - https://github.com/DUNE/lblpwgtools

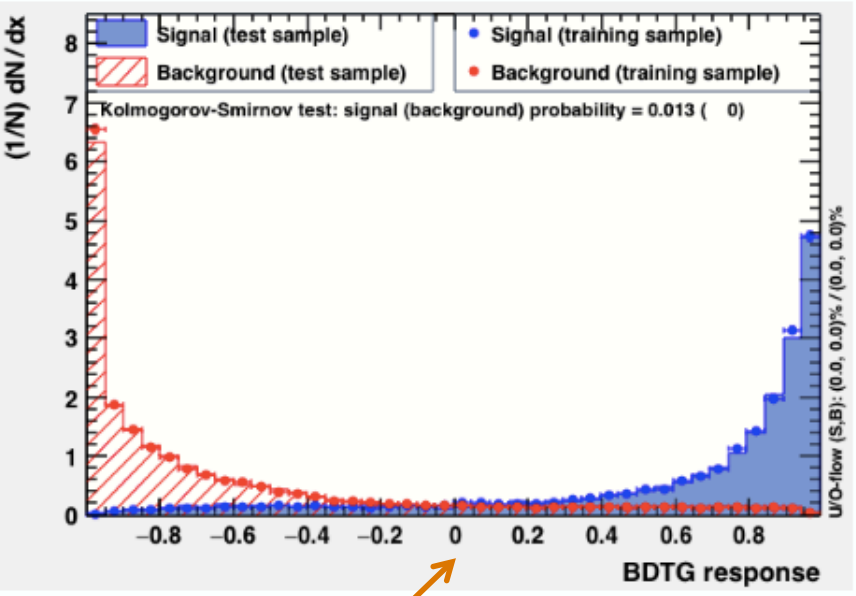
Note: Showing you some "working plots" from hack days here. Will make a more complete presentation of this work at next week's LBPWG meeting.

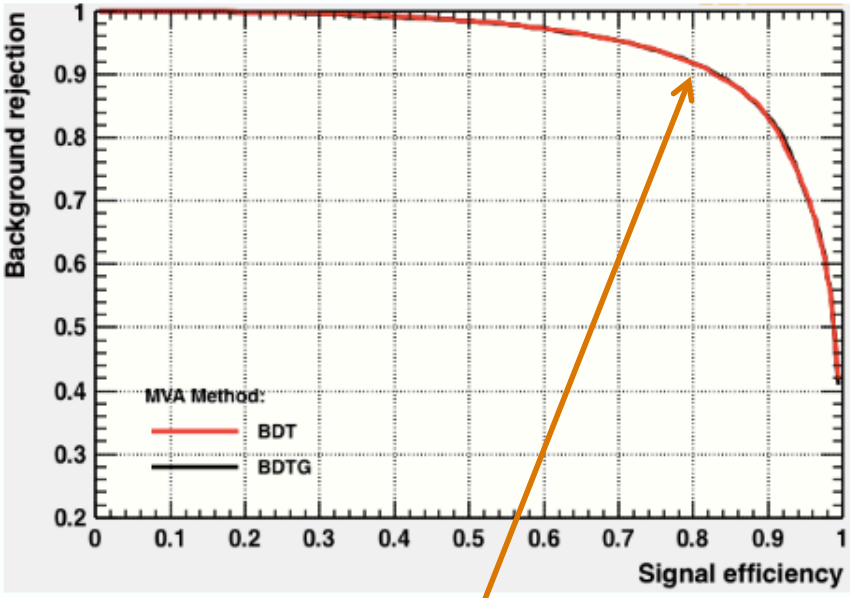
Reminder of CDR Efficiency

FHC:



Reminder of MVA Selection





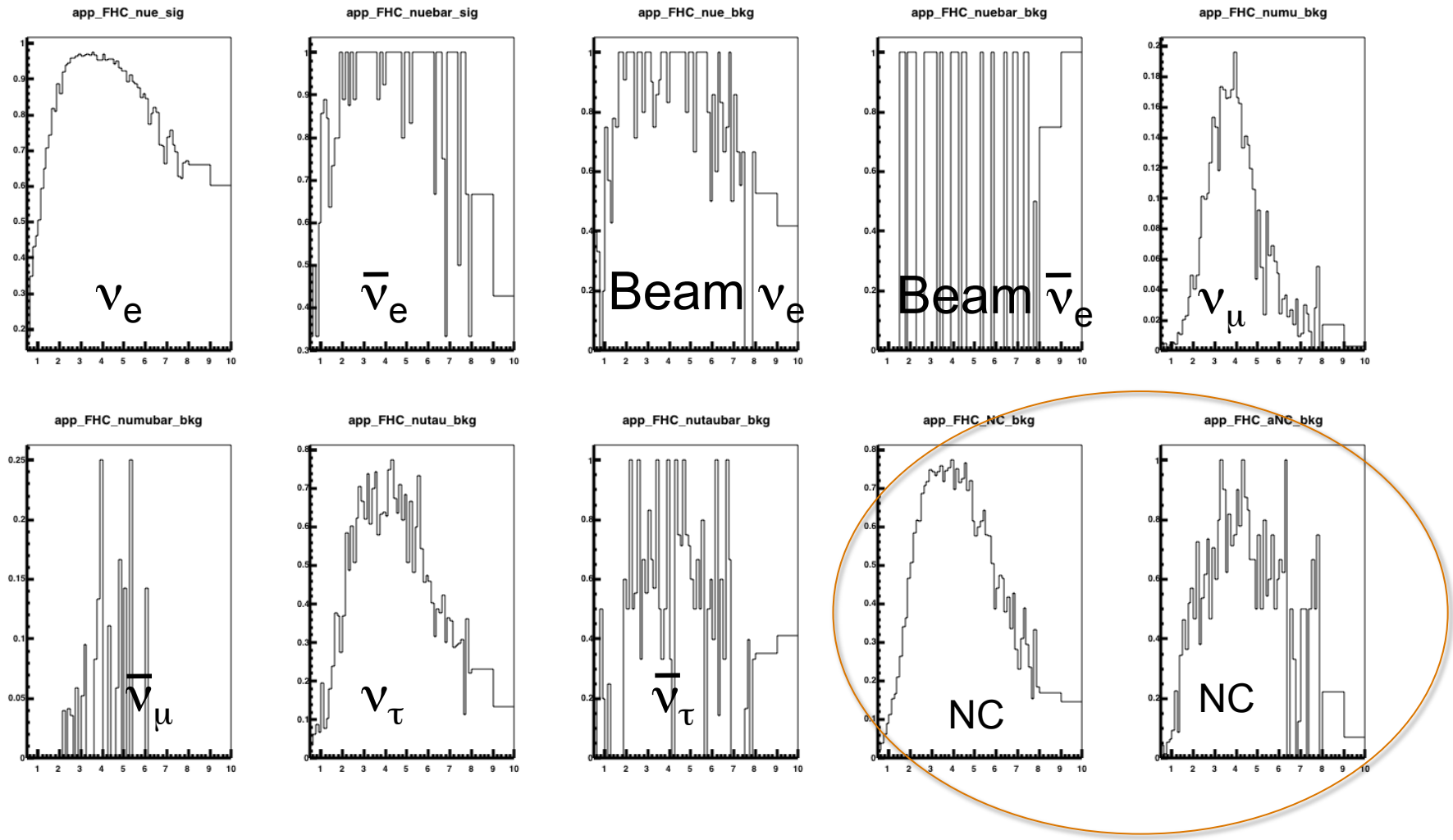
Currently cutting at zero – this could clearly be optimized, but given the bg level, probably not worth worrying about yet.

For ~80% signal efficiency, have ~8% background efficiency. Compare to ~0.4% in CDR. Cut at zero is >80% efficient for signal, so these results in very high background region.

Efficiency vs Ereco (FHC)

DEEP UNDERGROUND NEUTRINO EXPERIMENT

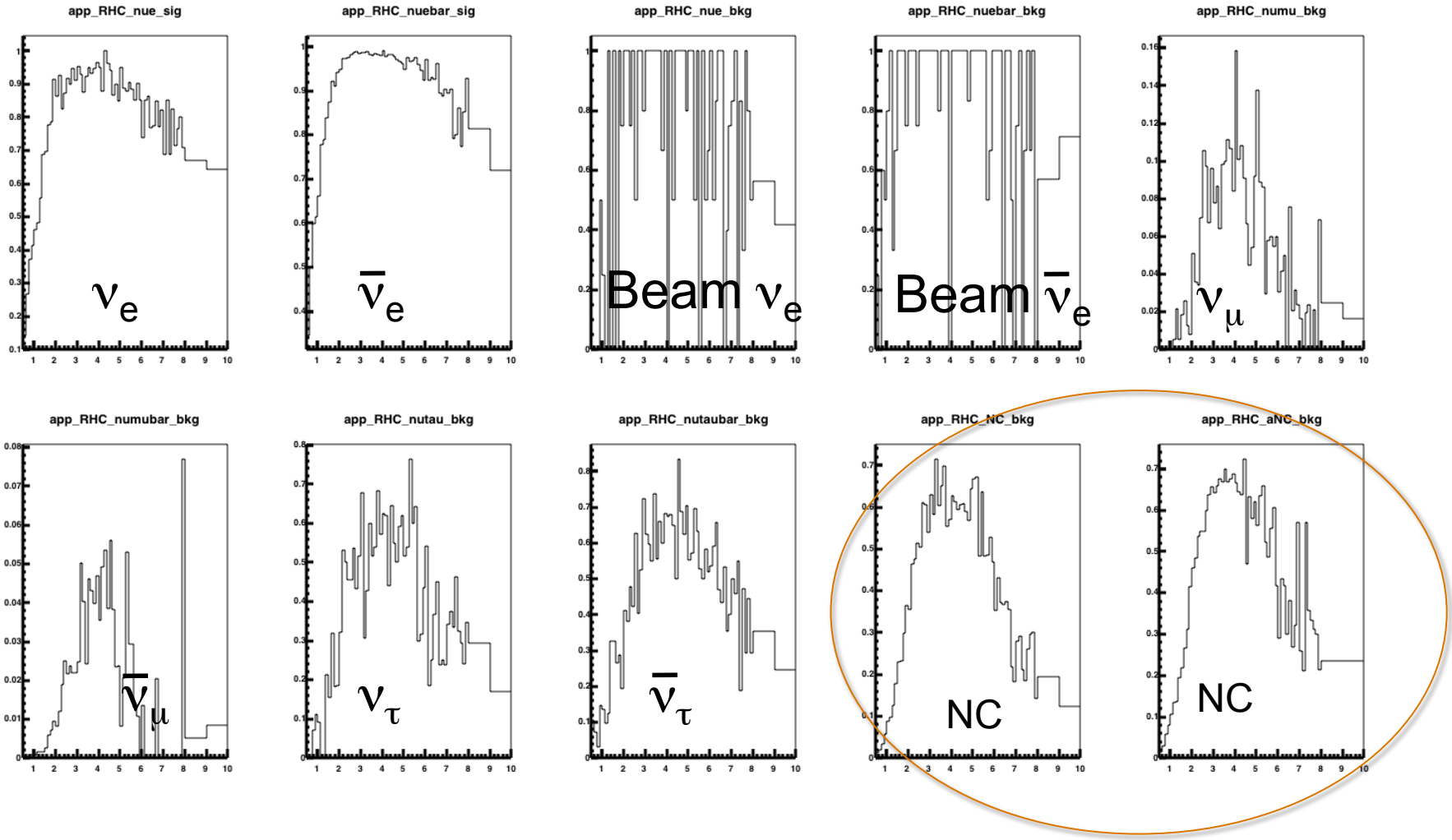
Working plots…will make nicer ones...



Efficiency vs Ereco (RHC)

DEEP UNDERGROUND NEUTRINO EXPERIMENT

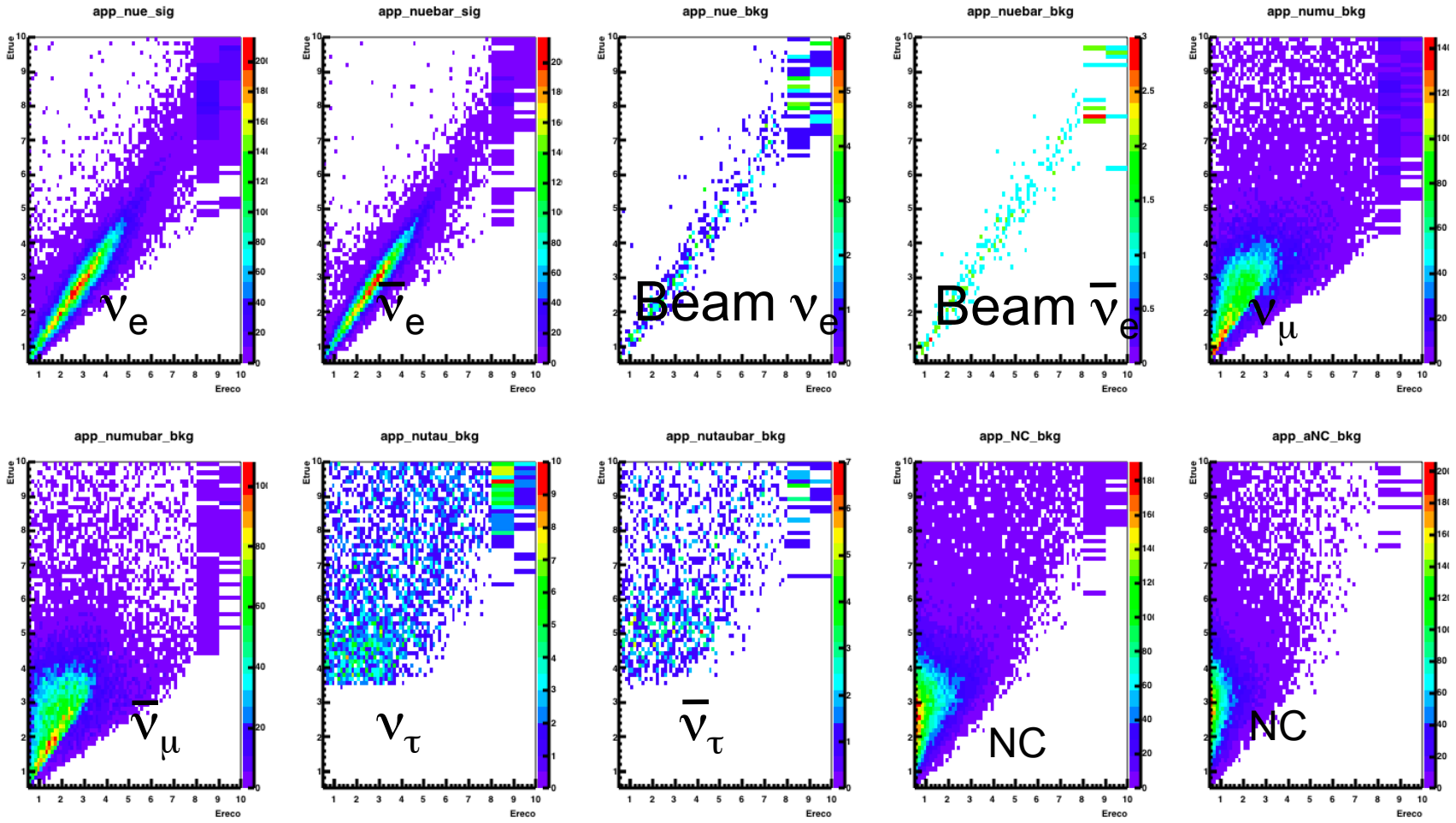
Working plots…will make nicer ones...



Smearing (FHC+RHC)

DEEP UNDERGROUND NEUTRINO EXPERIMENT

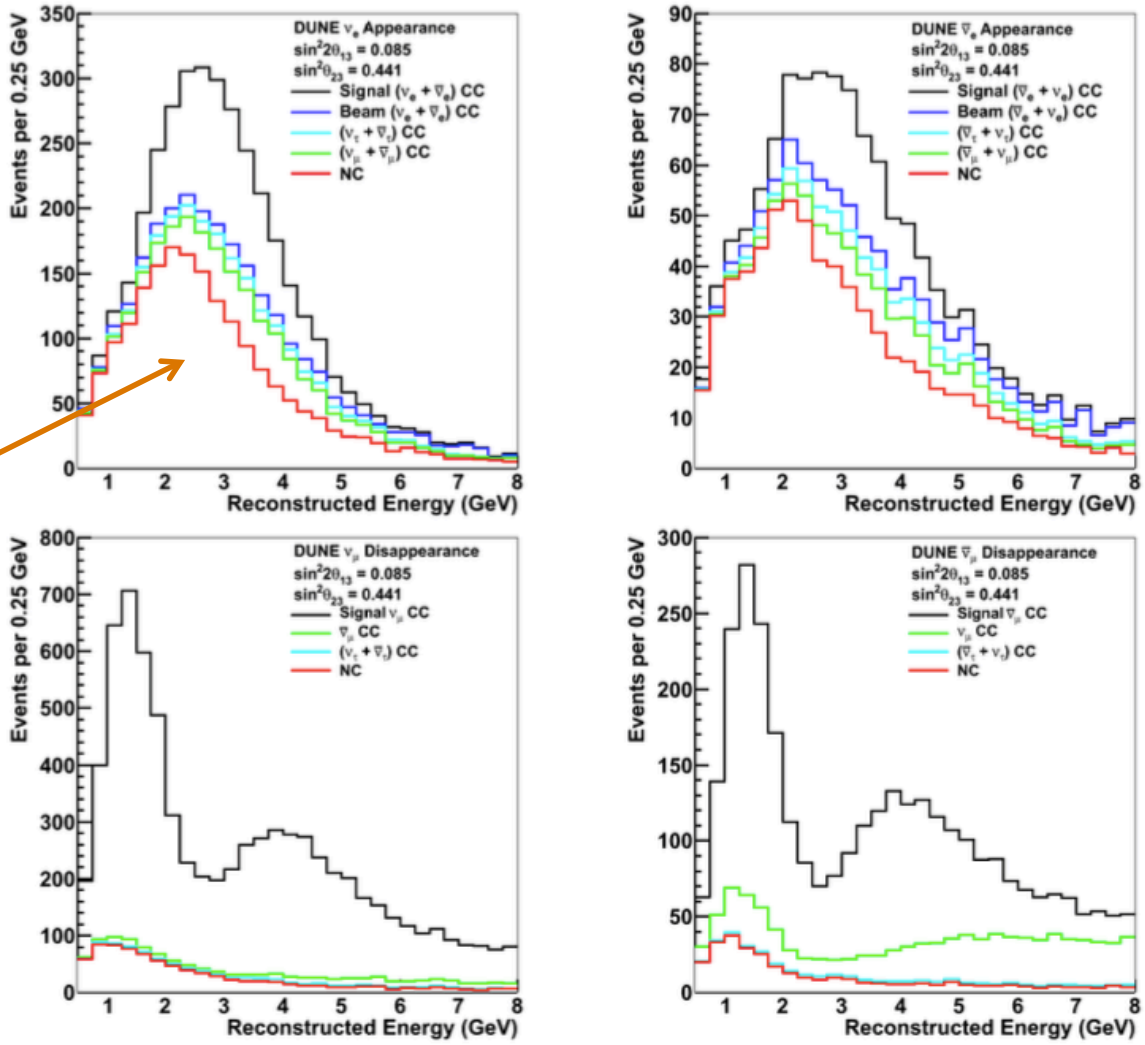
Working plots…will make nicer ones...



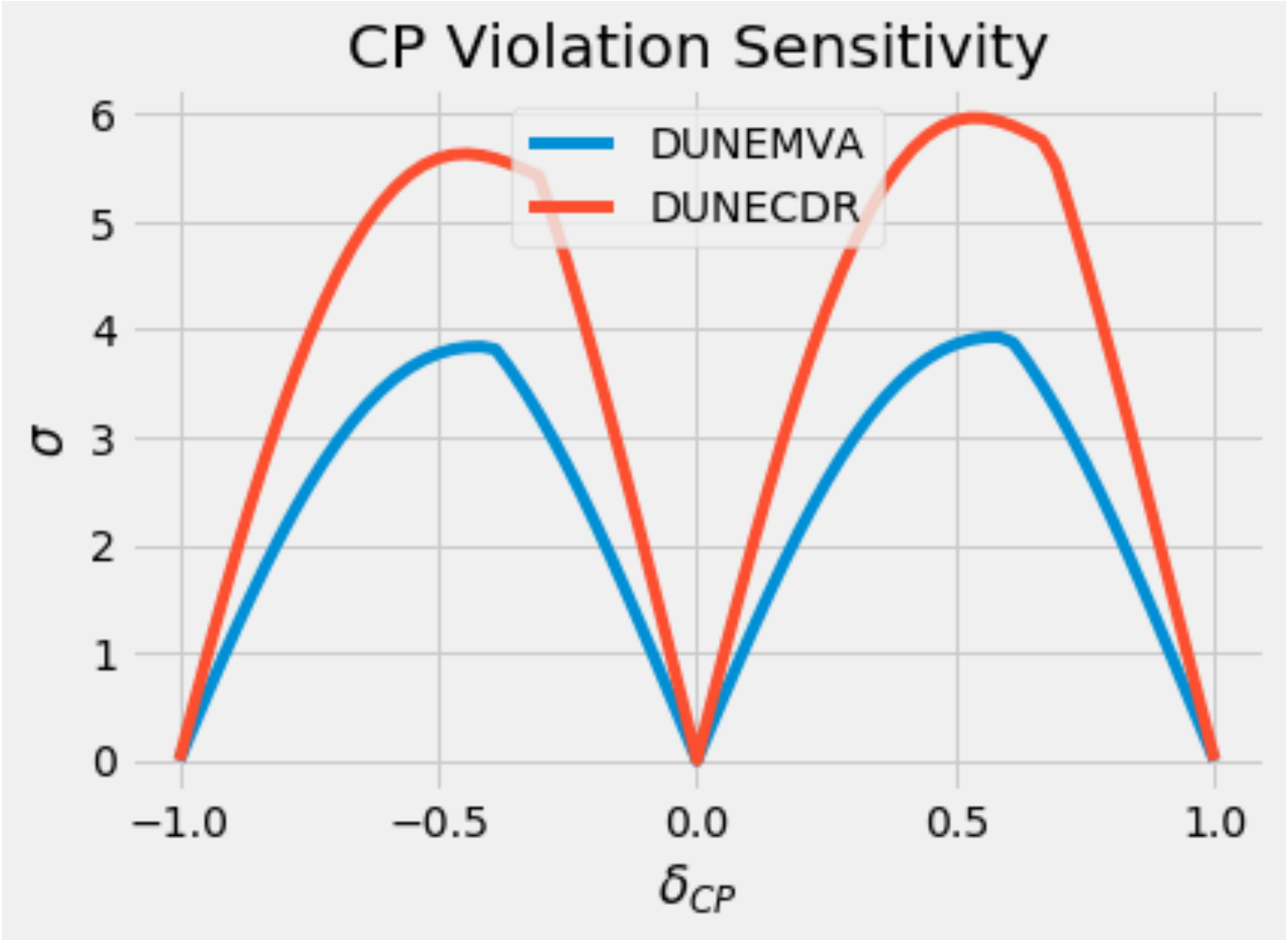
Spectra (3.5+3.5 years)

DEEP UNDERGROUND NEUTRINO EXPERIMENT

Huge
NC BG



Sensitivity



Summary

- Similar spectra extracted using CAFAna
- Even with around x100 NC background relative to CDR assumptions, still significant sensitivity to CPV, but this performance is obviously not good enough
- Appears to be plenty of room for improvement in MVA
  - Opportunity to contribute if any of us are interested
- This tool allows us to easily check impact of future improvements to reconstruction/selection